

108-Fiber & Gen54YY Delay Sets: Comparison with Spreadsheet Model

J. Ewen – JDSU

Contributions & Support:

Mike Lawton, Piers Dawe, David Cunningham

John Jaeger, Jonathan King

Tom Lindsay

Lew Aronson

Petar Pepeljugoski

Nick Weiner

Abhijit Shanbhag

Agilent

Big Bear

Clariphy

Finisar

IBM

Phyworks

Scintera

Simulation Parameters

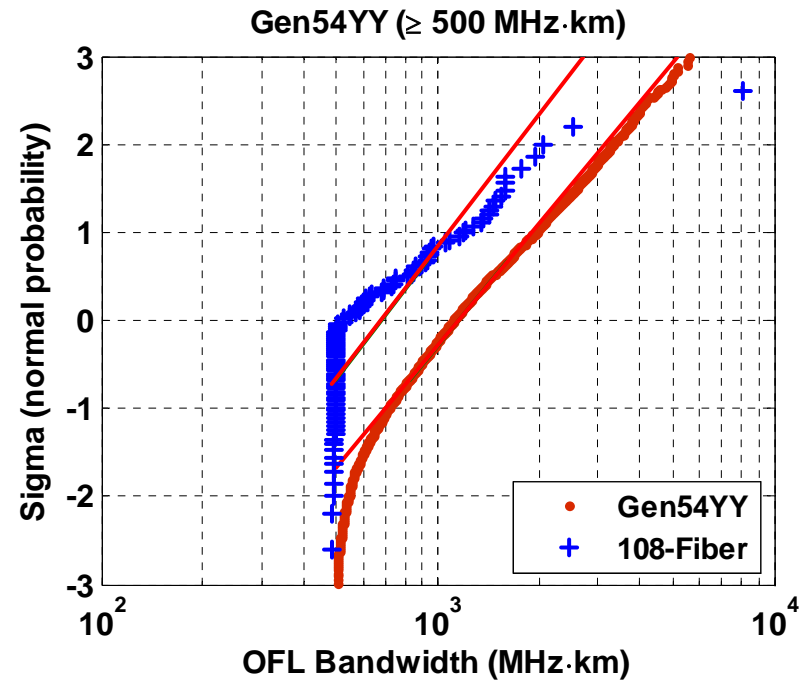
- Delay Sets
 - 108-fiber Release 2.1 (Cambridge)
 - 5000-fiber, Gen54YY (J. Abbott)
 - 18 mode-groups used in simulations
 - “Per offset” statistics unless otherwise noted
- Connector scenario #1
 - 2 connectors
 - Offset fixed at $7\mu\text{m}$ for both connectors
 - Include only MPD diffusion effects, i.e. Ignore delay spread between connectors
 - Use P. Pepeljugoski’s method to compute connector transfer matrix
 - Use with 108-fiber delay set
- Connector scenario #2 – “Monte Carlo”
 - 2 connectors
 - Use P. Pepeljugoski’s method to compute connector transfer matrix
 - Random offsets
 - Rayleigh distribution, mean= $3.58\mu\text{m}$, truncated at $7\mu\text{m}$
 - Include only MPD diffusion effects
 - Use with Gen54YY delay set

Simulations without EDC

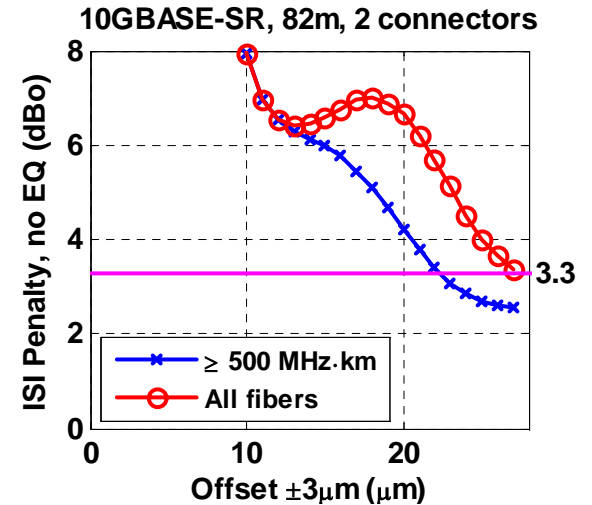
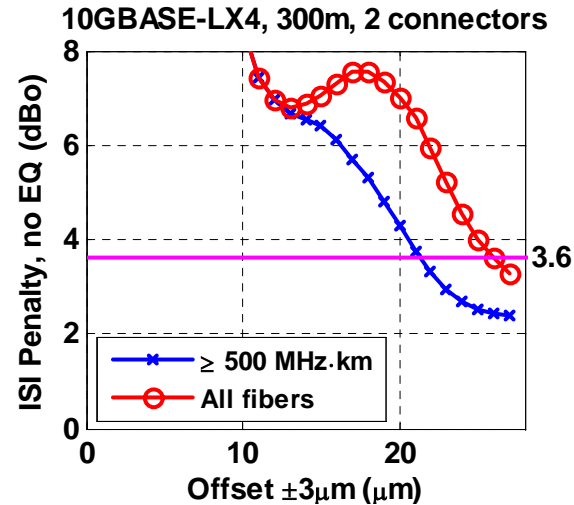
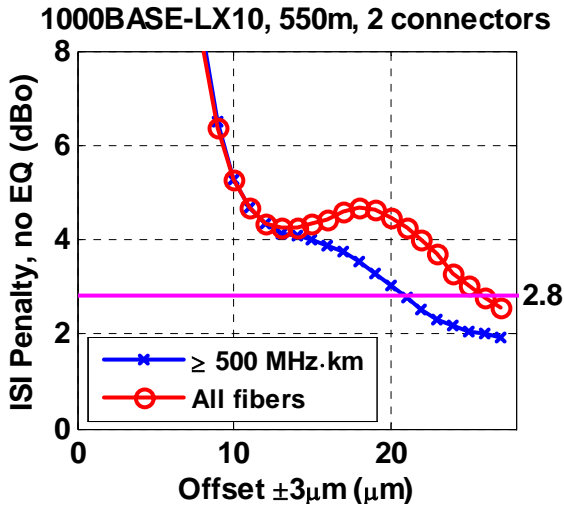
- Compute ISI penalty using peak distortion
 - Gen54YY: 99th percentiles, “per offset” statistics
 - 108-fiber: 80th percentiles, “per offset” statistics
- Compute 3 scenarios to compare with spreadsheet model
 - All three cases are based on 500 MHz·km OFL fiber bandwidth
- Two methods to compute %tiles
 - At each offset individually
 - Over $\pm 3\mu\text{m}$ window at each offset to mimic patch cord specification
- 10GBASE-LX4
 - 3.268 Gb/s (effective rate)
 - 120 ps 20%-80% risetime
 - 2.34 GHz Rx filter
 - Pisi ~ 3.6dB at 300m (from 10GEPBud3_1_16a.xls)
- 1000BASE-LX10 (62.5 μm MMF)
 - 1.389 Gb/s (effective rate)
 - 300 ps 20%-80% risetime
 - 0.9375 GHz Rx filter
 - Pisi ~ 2.8dB at 550m (from EFM0_0_2.7.xls)
- 10GBASE-SR (500 MHz·km fiber)
 - 11.202 Gb/s (effective rate)
 - 35 ps 20%-80% risetime
 - 7.5 GHz Rx filter
 - Pisi ~ 3.33dB at 82m (from 10GEPBud3_1_16a.xls)

Delay Set Characteristics

- Monte Carlo delay set
 - Retain fibers with OFL bandwidth ≥ 500 MHz·km
 - 384 fibers (7.7%) excluded
- 108-fiber delay set
 - Use all fibers in calculations

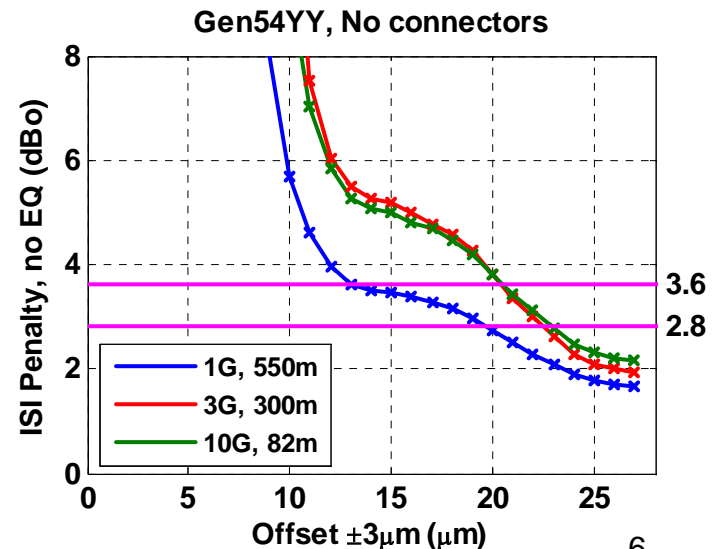
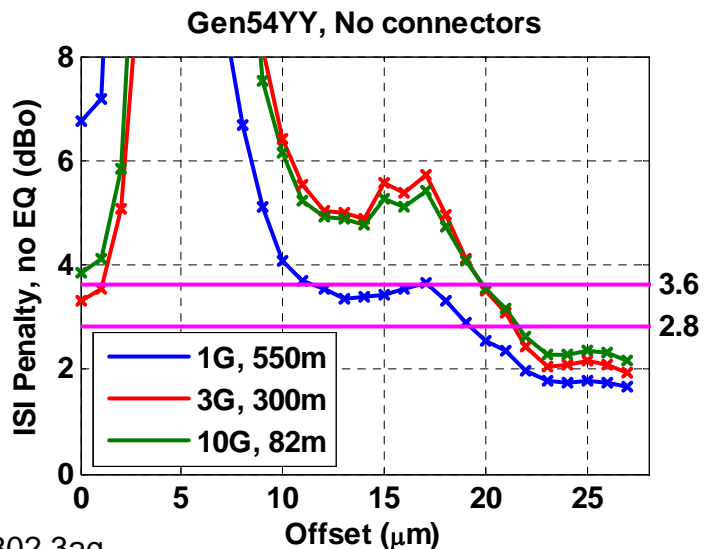
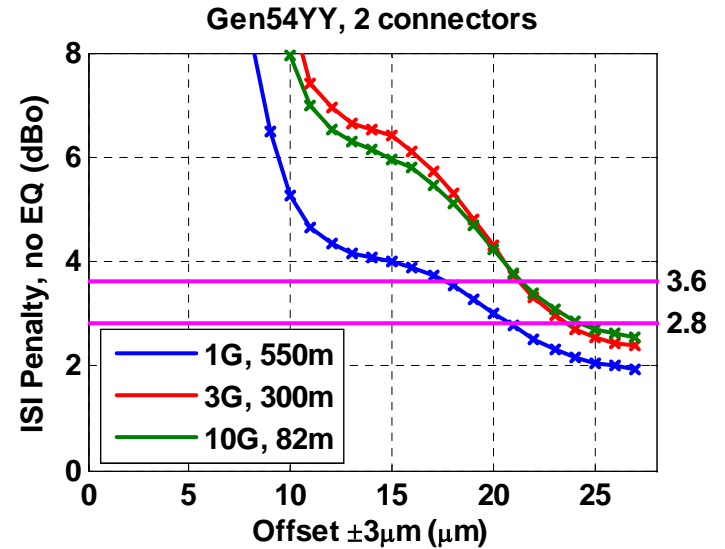
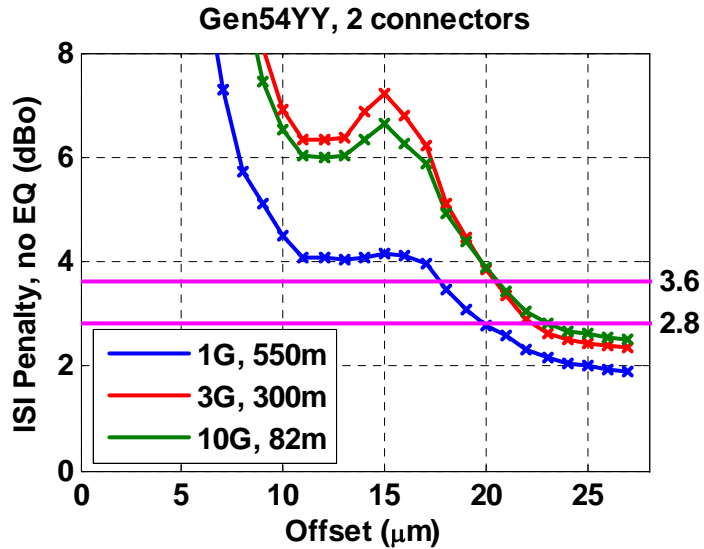


Gen54YY: ISI vs. OFL Bandwidth

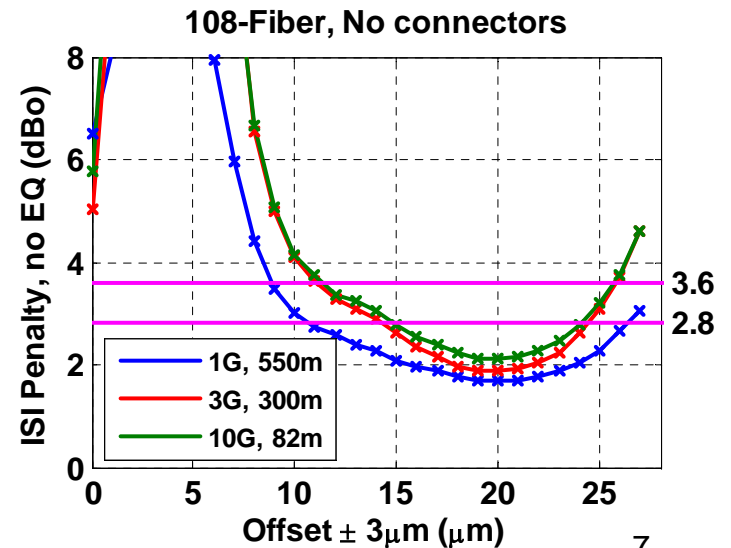
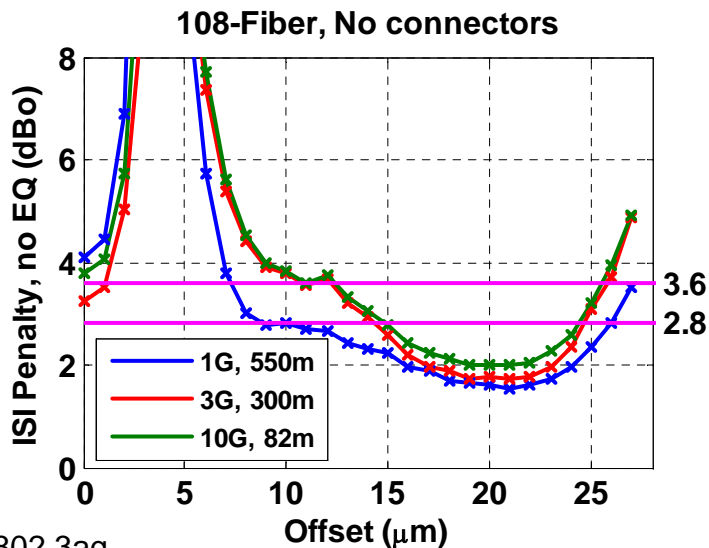
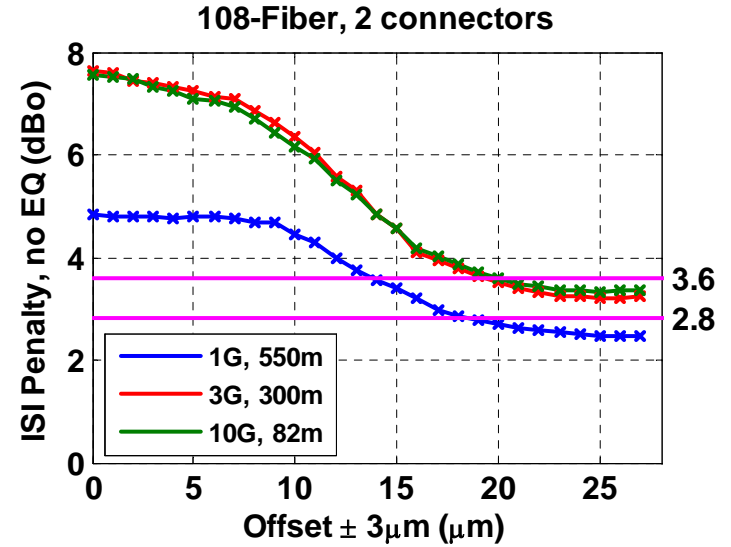
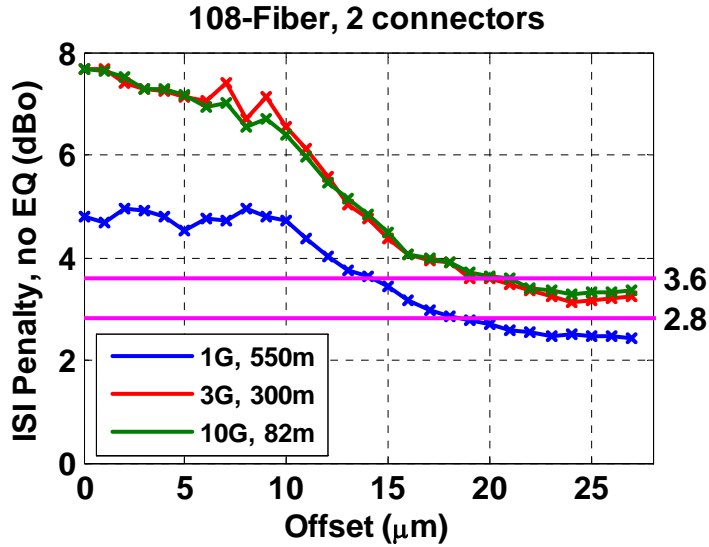


- Including all fibers (i.e. those with < 500 MHz.km)
 - Large effect for large OSL
 - 3 – 4 dB larger ISI penalties than predicted by spreadsheet model
- Subsequent slides only include Gen54YY fibers with ≥ 500 MHz.km OFL bandwidth

Gen54YY Delay Set

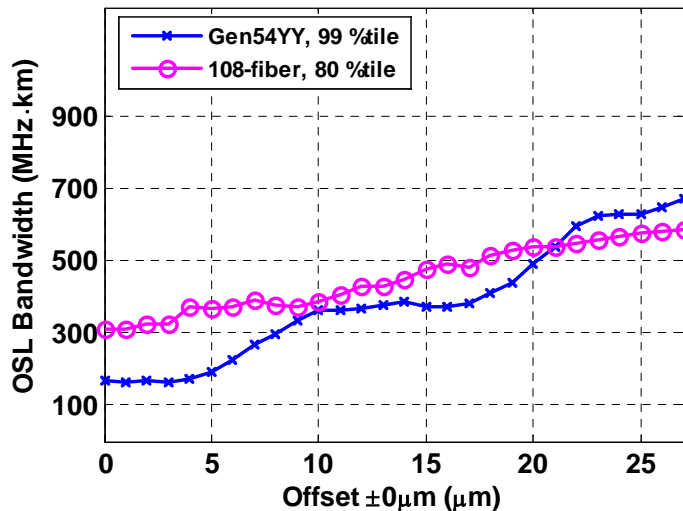


108-Fiber Delay Set

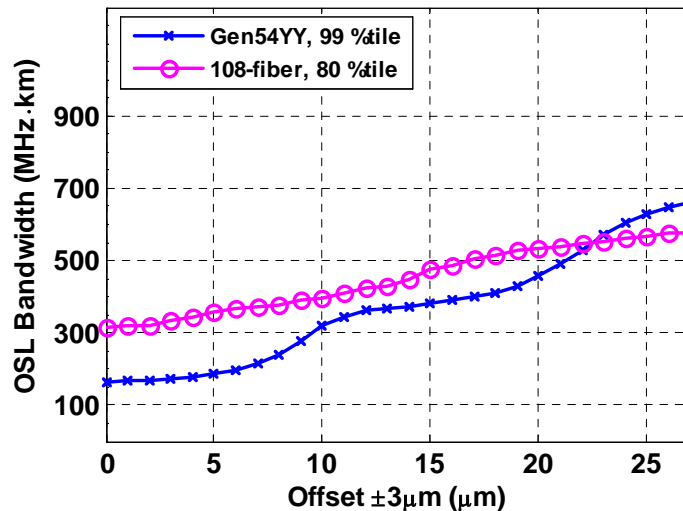


OSL Bandwidth

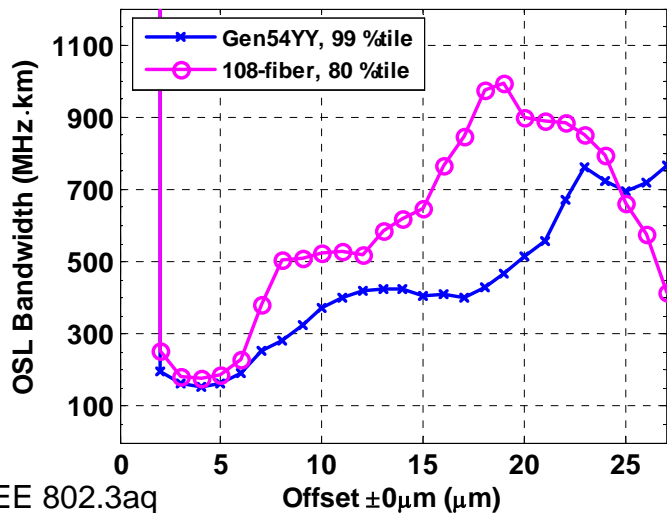
FDDI Fiber, 2 Connectors



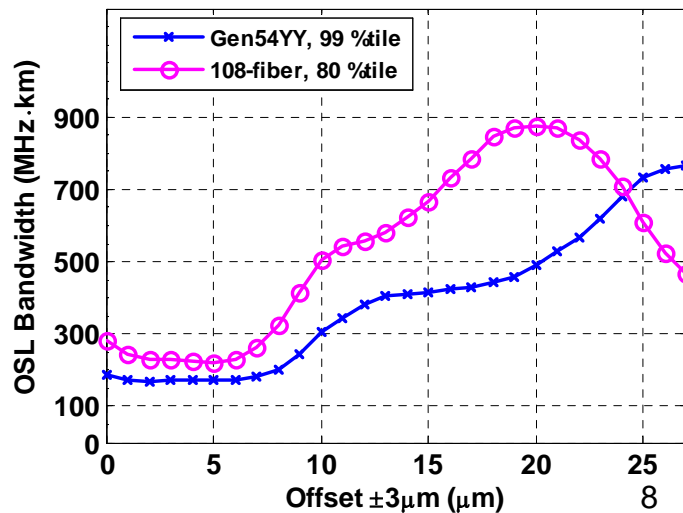
FDDI Fiber, 2 Connectors



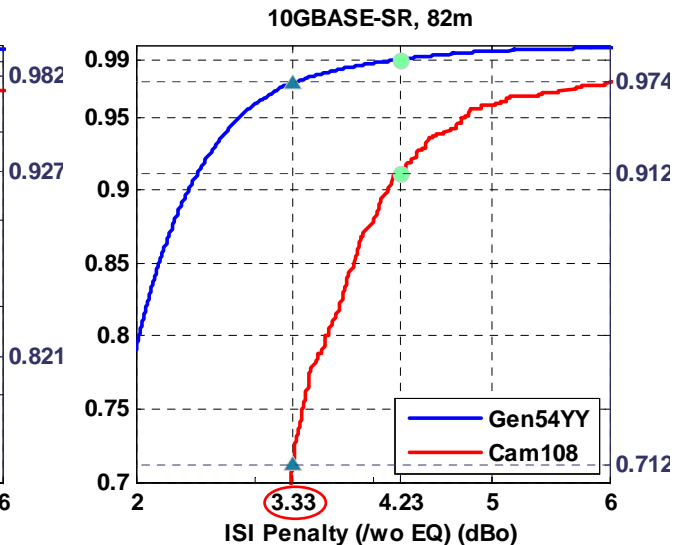
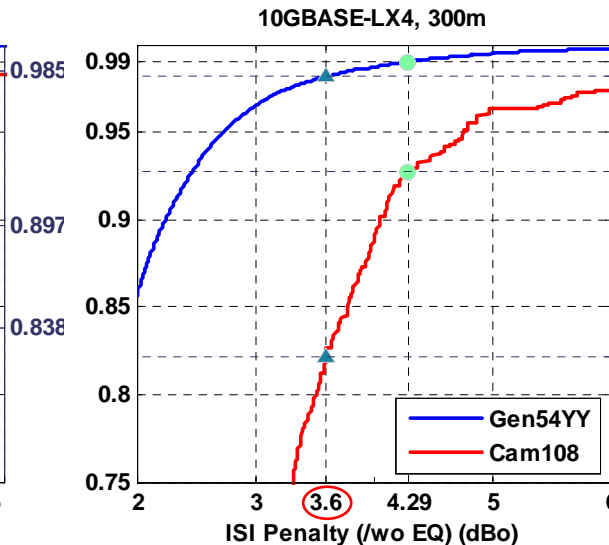
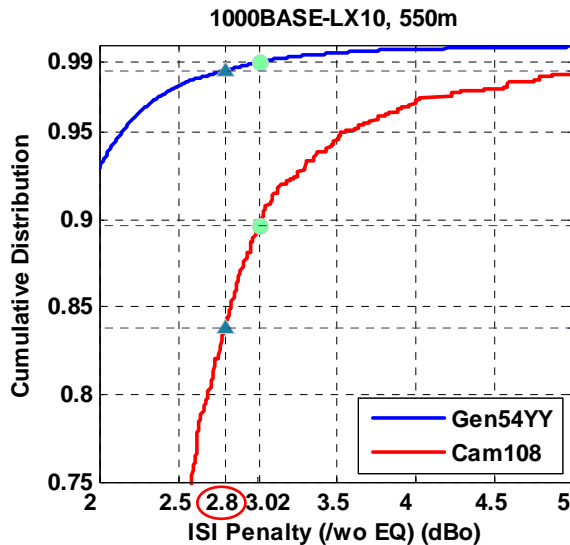
FDDI Fiber, No Connectors



FDDI Fiber, No Connectors



Cumulative Distributions



- 80th %tile 108-fiber
 - 0.1dB optimistic
- 99th %tile Gen54yy
 - 0.2dB pessimistic

- 80th %tile 108-fiber
 - 0.1dB optimistic
- 99th %tile Gen54yy
 - 0.7dB pessimistic

- 80th %tile 108-fiber
 - 0.3dB pessimistic
- 99th %tile Gen54yy
 - 0.9dB pessimistic

Conclusions

- Effect of connectors
 - Increase ISI penalties
 - Decrease advantages of conditioned launch
- 108-Fiber with connectors
 - 80th percentile agrees well with spreadsheet model (± 0.1 dB)
- Gen54YY with connectors
 - fibers < 500 MHz·km should be excluded from statistics
 - ~ 0.5 dB pessimistic relative to spreadsheet model